Analysis of sea surface sound speed near the Changjiang River mouth using passive microwave remote sensing

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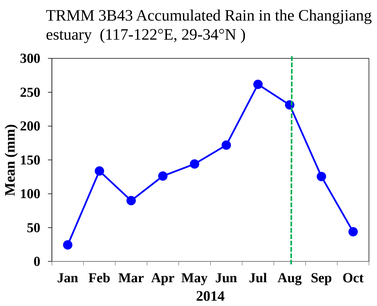
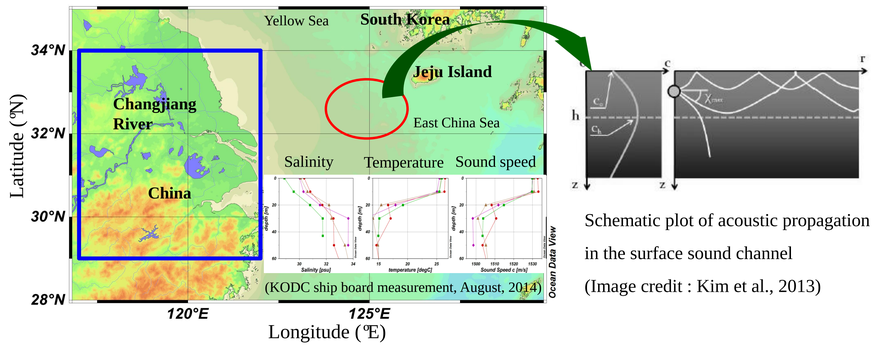
Abstract

Surface sound speed (SSSP) of the seawater was studied for the low salinity region in the Easy China Sea during the summer monsoon season. Sea surface temperature (SST) from NASA's AMSR-2 and sea surface salinity (SSS) from ESA Soil Moisture and Ocean Salinity (SMOS) mission were implemented. In this research, using sound speed formula, the advent of Acoustic Channel due to the unpredictable expansion of Changjiang River born freshwater was speculated by comparing SSSP with subsurface sound speed from numerically predicted salinity and temperature. Because the Acoustic Channel is created below the surface when the SSSP is lower (i.e. extremely low salinity or low temperature) than subsurface, its horizontal distribution may provide good understanding the acoustical impact of expanding freshwater into the open ocean.

Background

Underwater acoustic channel in the west coast of Jeju Island in the summer season





Schematic plot of acoustic propagation in the surface sound channel (Image credit : Kim et al., 2013)

Outflowing Changjiang River (CR) plume with a thickness of 10-15m depth has potential to result underwater acoustic channel near the west coast of Jeju Island the during the summer season (Kim et al., 2013). This research estimated the sound speed (SSP) in the East China Sea (ECS) using passive microwave remote sensing and mapped the spatial distribution of the acoustic channel in August, 2014.

Data and method

a. Data

Data sources		Parameter	Dates of averaging
Prediction model	HYCOM	Salinity, temperature	August 3-9, 2014
Satellite	AMSR2	SST (7 day averaged)	August 3-9, 2014
	SMOS	SSS (Level-2 swaths)	August 3-13, 2014

b. Flagging level-2 SMOS SSS considering radio frequency interference (RFI)/land contamination : see Appendix C in Kil (2015)

c. Sound speed (SSP) by Medwin, (1975) :

$$SSP\ (m/sec) = 1449.2 + 4.6T - 0.55T^2 + 0.00029T^3 + (1.34 - 0.01T)(S-35) + 0.016Z$$

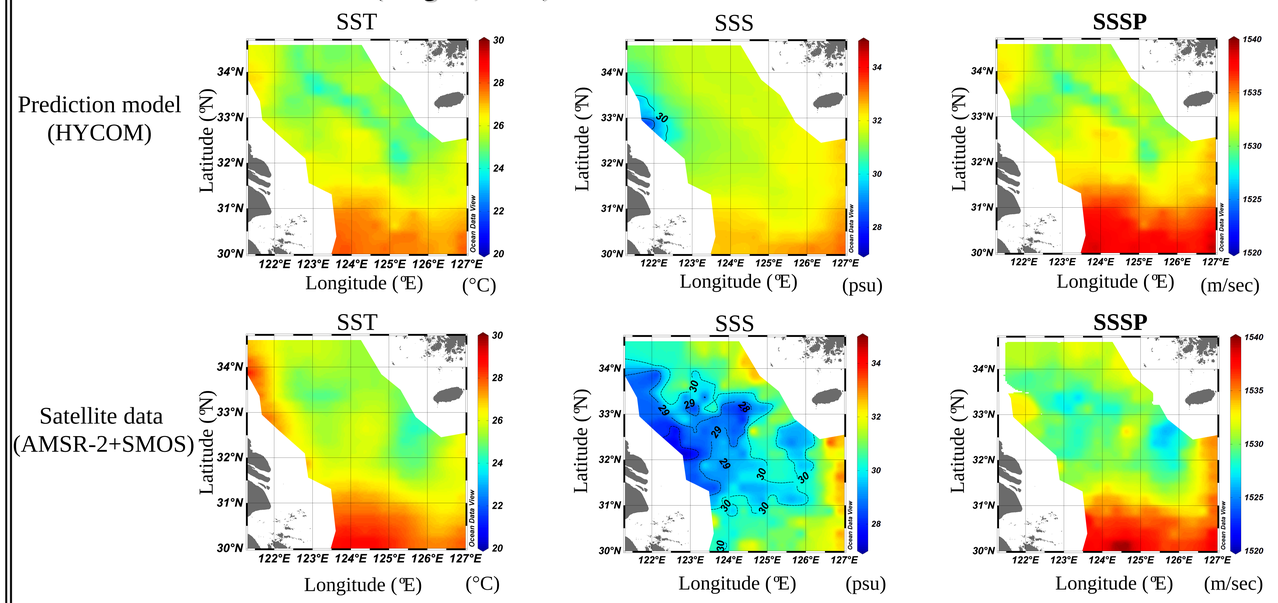
T : Temperature (°C), S : Salinity (psu), Z : Depth (m)

d. $\Delta SSP : SSP_{0m} - SSP_{10m}$

SSP_{0m} : Surface sound speed (SSSP) , SSP_{10m} : SSP at depth 10m estimated by HYCOM ($SSP_{HYCOM(10m)}$)

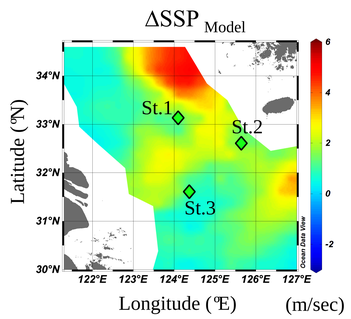
Potential acoustic channel in the ECS : $\Delta SSP < -0.2$ m/sec (Kim et al., 2013)

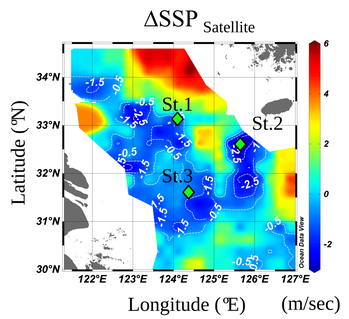
SSSP from different sources (August, 2014)

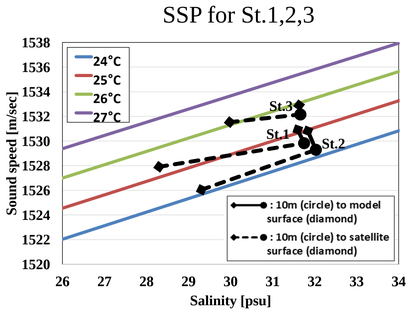


Expanding Low salinity water near the mouth of CR (< 30 psu) was found creating lower SSSP than modeled one

ΔSSP ($SSSP - SSP_{HYCOM(10m)}$) from different SSSP







Satellite based ΔSSP shows potential acoustic sound channel distributed around outflowing CR plume (white colored line) with large difference in salinity between surface and 10 meter depth rather than model based ΔSSP.

4. Conclusion

Acoustic sound channel in the ECS which is rarely appeared in the numerical model was successfully presented as moving toward Jeju Island by using passive microwave remote sensing satellite AMSR-2 and SMOS. Replacing predicted SSS and SST by satellite born SSS and SST resulted lower surface sound speed then 10m depth of the modeled sound speed on the low salinity dominated CR mouth. SMOS's capability to measure the low salinity water contributed estimating better realistic surface sound speed than modeled one.

5. Acknowledgement

SMOS Level 2 Ocean Salinity data was provided by European Space Agency downloaded by the Earth Observation Link (http://earth.esa.int/EOLi /EOLi. html). . The in situ data was supplied by Republic of Korea National Fisheries Research and Development Institute by Korea Oceanographic Data Center at http://kodc.nfrdi.re.kr. AMSR data are produced by Remote Sensing Systems and sponsored by the NASA Earth Science MEaSUREs DISCOVER Project and the NASA AMSR-E Science Team. Data are available at www.remss.com. Data assimilative products using HYCOM are funded by the U.S. Navy. Computer time was made available by the DoD High Performance Computing Modernization Program. The output is publicly available at http://hycom.org. The precipitation data used in this study were obtained as part of the mission of NASA's Earth Science Division and archived and distributed by the Goddard Earth Sciences (GES) Data and Information Services Center (DISC) at http://daac.gsfc.nasa.gov/.

6. REFERENCE

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